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No. 3

RESEARCH AID

COSTS OF MAINTENANCE AND REPAIR OF THE SOVIET MARITIME FLEET 1950-55

CIA/RR RA 26
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CENTRAL INTELLIGENCE AGENCY

OFFICE OF RESEARCH AND REPORTS

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(ORR Project 35.1666)

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FOREWORD

Costs of maintenance and repair of the Soviet maritime fleet represent a considerable expenditure of economic effort. Because no direct information on these costs was available, techniques of indirect estimation had to be used. This research aid summarizes the results of these techniques of estimation for 1950-55. It should be emphasized that the estimates given in this research aid are first approximations, subject to refinement as additional information becomes available.

CONTENTS

Appendixes

25X1

Tables

Illustrations

COSTS OF MAINTENANCE AND REPAIR OF THE SOVIET MARITIME FLEET* 1950-55

Summary

Costs of maintenance** and repair of the Soviet maritime fleet are estimated to have increased from 220 million rubles*** in 1950 to 287 million rubles in 1955,**** a growth comparable with the increase in the size of the maritime fleet. Costs of maintenance and repair for 1955 are estimated to be equivalent to the cost of construction of about 73,000 gross register tons (GRT)† of dry cargo maritime vessels. The average annual costs of maintenance and repair per gross register ton for 1950-55 are estimated to be about 119 rubles.

For comparison, an alternative set of estimates of Soviet costs of maintenance and repair, in dollars, was computed by analogy with US costs. The US average annual costs of maintenance and repair per gross register ton were estimated to be $22.

1. Introduction.

Costs of maintenance and repair of Soviet maritime vessels were estimated indirectly from scanty information in available Soviet sources, inasmuch as no direct information on these Soviet costs are available. Estimates were developed by valuing costs of direct

* The estimates and conclusions contained in this research aid represent the best judgment of ORR as of 15 December 1957.

** The term maintenance as used in this research aid refers to such maintenance work as is performed by the shipyard as a normal part of scheduled ship repair.

*** Ruble values are given in 1951-55 plan rubles and dollar values in 1955 US dollars throughout this research aid, unless otherwise indicated.

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† Gross register tonnage is a measure wherein the entire internal cubic capacity of the vessel less certain minor exceptions is expressed in register tons (100 cubic feet to the ton).

labor* on the basis of an estimated wage rate for the shipbuilding industry and a Soviet schedule of norms which indicated the hours of direct labor consumed in ship maintenance and repair, by size and type of ship. [redacted]

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2. Estimates of Costs of Maintenance and Repair.

a. Estimates of Costs.

The estimated total cost of maintenance and repair of the Soviet maritime fleet in 1955 was almost 287 million rubles, an increase of 30 percent more than the estimated total cost of 220 million rubles in 1950, as shown in Figure 2.** This increase parallels the growth of the Soviet maritime fleet during the same period. The 1955 costs of maintenance and repair were estimated to be equivalent to the costs of construction of about 73,000 GRT of dry cargo maritime vessels.***

The above estimates of costs of maintenance and repair represent a summation of costs for the following three main categories -- capital, medium, and current.**** The estimates depend on the size

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[redacted]

**** The USSR classifies ship maintenance and repair of vessels under the following three categories: (1) current repair, which must be done on a current basis to provide for proper operation of vessels; (2) medium or intermediate repair, which is a periodic overhaul of a vessel scheduled every 4 years, providing for inspection and repair of major components of a vessel; and [footnote continued on p. 3]

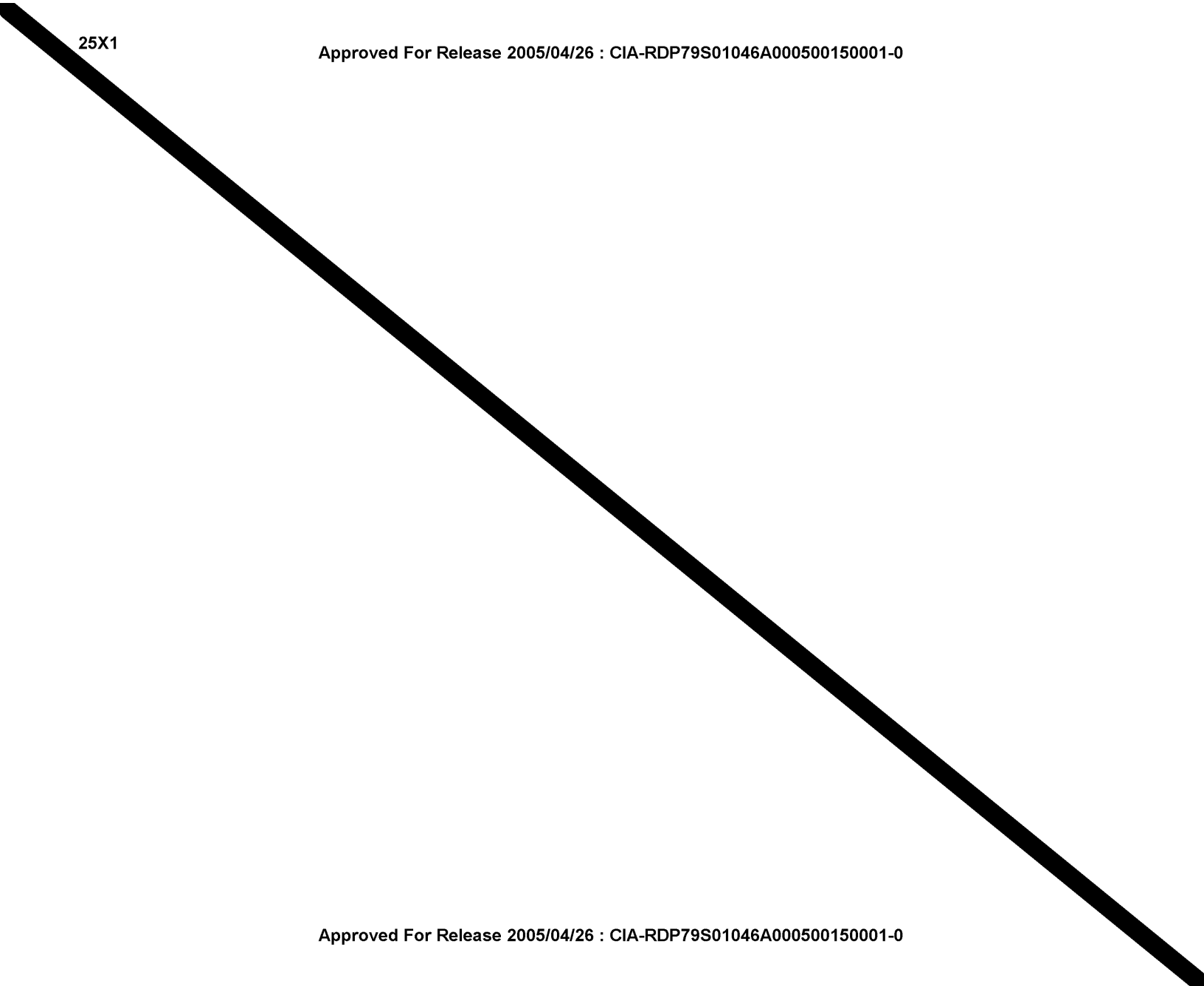

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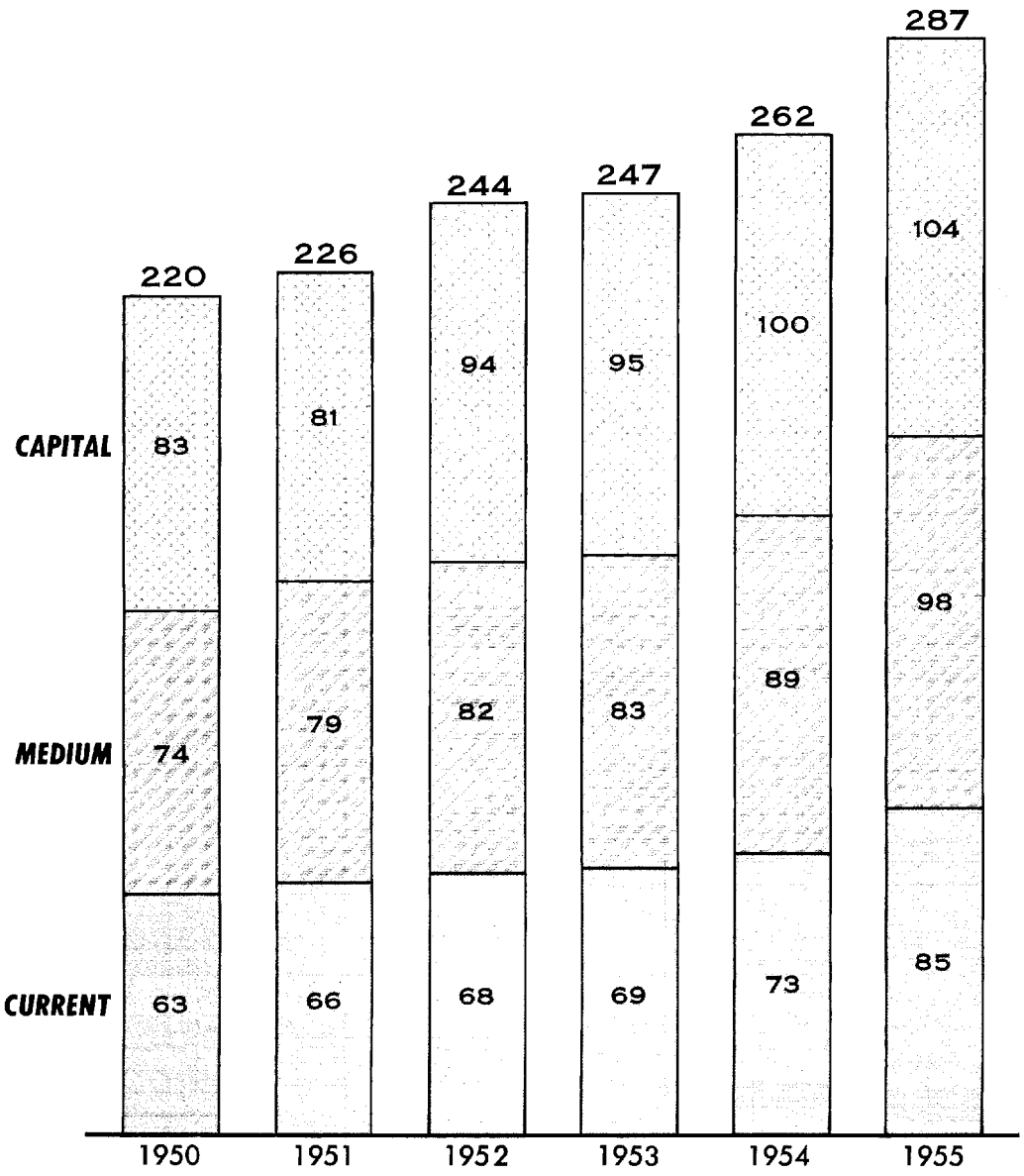
Figure 2

USSR

ESTIMATED COSTS OF MAINTENANCE AND REPAIR OF THE SOVIET MARITIME FLEET

(Million 1955 Rubles)



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of the fleet of maritime vessels (see Table 1*), on costs of direct labor (see Table 2**), and on distribution of maritime vessels by age (see Table 7***). The categories of work differ according to the frequency of their occurrence and the scope of the work or overhaul undertaken in each category, capital repair being the most extensive and least frequent and current repair the least extensive and most frequent. Because differing proportions of each type of repair are accomplished each year, during 1950-55 there was some yearly variation from a low of 114 rubles to a high of 124 rubles. The average annual Soviet costs of maintenance and repair per gross register ton for 1950-55 was 119 rubles, an average which may be compared with a US average annual cost of $22 per gross register ton for 1949-55.****

Estimated cost of capital repair alone was 104.7 million rubles in 1955, 26 percent greater than that in 1950; of medium repair, valued at 97.5 million rubles, 32 percent greater than that in 1950; and of current repair, valued at 84.9 million rubles, 35 percent greater than in 1950. The growth of costs of current and medium repair at a faster rate than that of capital repair is explained by the decreasing average age of the Soviet maritime fleet during 1950-55 as new tonnage added to the fleet exceeded tonnage retired. Year-by-year estimates of costs of each of the three main categories of maintenance and repair and total costs of maintenance and repair are shown in Figure 2.†

b. Basis for Estimates.

The number of man-hours required for each of the 3 categories of maintenance and repair for the average Soviet maritime vessel of 3,400 GRT (see Table 1*) was estimated from a Soviet schedule of norm man-hours in maintenance and repair of vessels.†† 4/ The norm

(3) capital repair, which has a plan schedule of every 12 years and is a more or less complete rebuilding of worn or damaged parts of the hull or machinery. 1/ [redacted] 25X1

25X1 [redacted]

* Appendix B, p. 9, below.
** Appendix B, p. 10, below.
*** Appendix B, p. 13, below.
**** Analogous data are computed in Appendix C.
† Following p. 2.
†† Soviet reports mention both overfulfillment 2/ and underfulfillment 3/ of norms for repair of vessels. On the basis of information currently available the relationship between norms and experience cannot be judged. Therefore, it was assumed that the norms are approximately correct reflections of actual experience.

man-hours for each category of repair for the average ship multiplied by the number of ships needing each category of repair gives the estimated total man-hours required for each category of repair for the total fleet. (See Table 2.*) These man-hours multiplied by the estimated average wage for shipbuilding of 3.4 rubles per hour 5/ gives the costs of direct labor of repair for each category of repair. (See Tables 3, 4, and 5.**)

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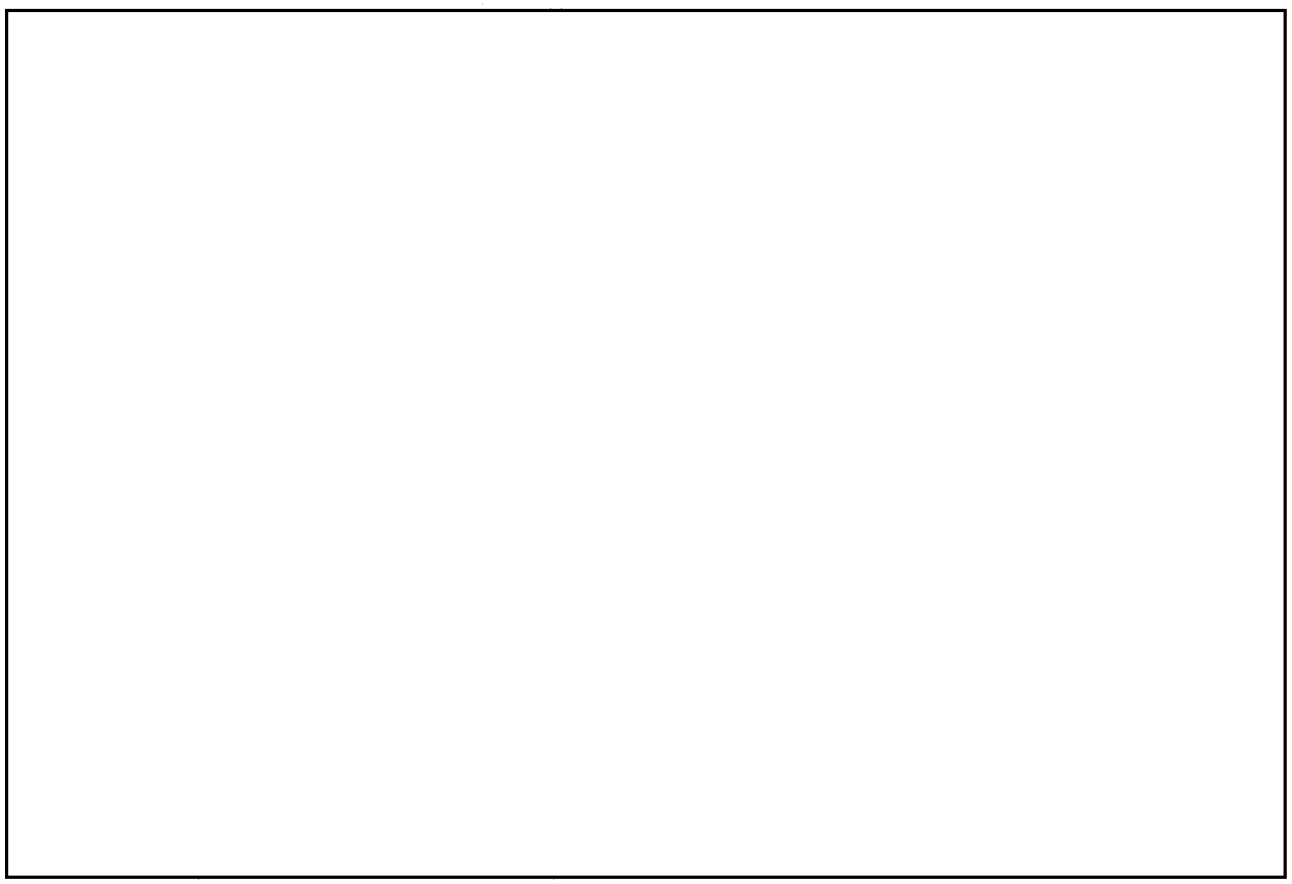

The number of ships in different categories of repair was estimated by combining the Soviet schedules for different categories of repair with an estimate of the age distribution of the fleet. It is assumed, following the Soviet schedule, that 1/12 of Soviet ships more than 12 years old undergo capital repair each year and that 1/4 of the remaining ships which are more than 4 years old undergo medium repair each year. The remaining ships undergo current repair each year. The age distribution of the Soviet maritime fleet was available only for the years 1951, 9/ 1954, 10/ and 1956, 11/ and

* Appendix B, p. 10, below.
** Appendix B, pp. 11 and 12, below.

the unknown years were estimated from these years. (See Table 7.*) Combining the repair plan and the age distribution of the fleet yielded the number of ships in each category of repair. (See Table 2.**)

Total costs of each category of maintenance and repair for the maritime fleet then could be estimated as shown in Figure 2.*** Total costs of repair for the fleet together with the average cost per gross register ton by year are derived from the costs for each class of repair. (See Table 6.****)

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* Appendix B, p. 13, below.
** Appendix B, p. 10, below.
*** Following p. 2.
**** Appendix B, p. 12, below.

APPENDIX A

COMPARISON OF COSTS OF MAINTENANCE AND REPAIR OF THE SOVIET MARITIME FLEET WITH COSTS OF NEW CONSTRUCTION

Costs per light ship displacement ton* of dry cargo vessels in the USSR in 1955 equaled 5,800 plan rubles. 12/ Total estimated costs of maintenance and repair in 1955 equaled 287.1 million rubles. (See Table 6.**) Total estimated costs of maintenance and repair divided by costs per light ship displacement ton gave the following equation:

$$\frac{287,100,000}{5,800} = 49,500 \text{ LSD.}$$

Light ship displacement x 1.47 equaled gross register tonnage, or 49,500 x 1.47 equaled 72,765, or 73,000 GRT (rounded), of maritime dry cargo vessels.

* Light ship displacement (LSD) is the weight (in metric tons) of the vessel complete, ready for service in every respect, including permanent ballast and liquids in the machinery at operating levels but excluding the crew and their effects and all items of consumable or variable load such as stores, fuel, and cargo.

** Appendix B, p. 12, below.

APPENDIX B

STATISTICAL TABLES

Table 1

Size of the Maritime Fleet and Average Size of Maritime Vessels of the USSR
1950-55

Year	Number of Ships	Total (Gross Register Tons)	Average Vessel a/ (Gross Register Tons)
1950	545 b/	1,922,241 b/	3,527
1951	564 b/	1,949,048 b/	3,456
1952	598 b/	2,002,175 b/	3,348
1953	604 b/	2,000,315 b/	3,312
1954	638 c/	2,123,815 c/	3,329
1955	730 d/	2,494,192 d/	3,417

a. The average size of maritime vessels for 1950-55 was 3,400 gross register tons.
b. 13/
c. 14/
d. 15/

Table 2

Estimates of Direct Labor Required for Maintenance and Repair of the Maritime Fleet of the USSR
1950-55

Year	Capital Repair: Number of Ships	Capital Repair: Direct Labor a/ (Thousand Man-Hours)	Medium Repair: Number of Ships	Medium Repair: Direct Labor b/ (Thousand Man-Hours)	Current Repair: Number of Ships	Current Repair: Direct Labor c/ (Thousand Man-Hours)
1950	35	4,410	116	5,220	394	5,910
1951	36	4,536	117	5,265	411	6,165
1952	39	4,914	129	5,805	430	6,450
1953	40	5,040	130	5,850	434	6,510
1954	42	5,292	140	6,300	456	6,840
1955	44	5,544	153	6,885	533	7,995

a. Man-hours in capital repair equal 126,000 man-hours per vessel 16/ multiplied by the number of vessels in capital repair.
b. Man-hours in medium repair equal 45,000 man-hours per vessel 17/ multiplied by the number of vessels in medium repair.
c. Man-hours in current repair equal 15,000 man-hours per vessel 18/ multiplied by the number of vessels in current repair.

Table 3

Estimated Costs of Capital Repair of the Maritime Fleet of the USSR a/
1950-55

Year	Direct Labor b/ (Thousand Man-Hours)	Costs of Direct Labor (Thousand Rubles)	Total Costs (Million Rubles)
1950	4,410	14,994	83.3
1951	4,536	15,422	85.7
1952	4,914	16,708	92.8
1953	5,040	17,136	95.2
1954	5,292	17,993	100.0
1955	5,544	18,850	104.7

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Table 4

Estimated Costs of Medium Repair of the Maritime Fleet of the USSR a/
1950-55

Year	Direct Labor b/ (Thousand Man-Hours)	Costs of Direct Labor (Thousand Rubles)	Total Costs (Million Rubles)
1950	5,220	17,748	74.0
1951	5,265	17,901	74.6
1952	5,805	19,737	82.2
1953	5,850	19,890	82.9
1954	6,300	21,420	89.2
1955	6,885	23,409	97.5

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Table 5

Estimated Costs of Current Repair of the Maritime Fleet of the USSR a/
1950-55

Year	Direct Labor b/ (Thousand Man-Hours)	Costs of Direct Labor (Thousand Rubles)	Total Costs (Million Rubles)
1950	5,910	20,094	62.8
1951	6,165	20,961	65.5
1952	6,450	21,930	68.5
1953	6,510	22,134	69.2
1954	6,840	23,256	72.7
1955	7,995	27,183	84.9

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Table 6

Estimated Costs of Repair of the Maritime Fleet of the USSR
1950-55

Year	Total Costs of Repairs a/ (Million Rubles)	Costs per Gross Register Ton Per Year b/ (Rubles)
1950	220.1	114
1951	225.8	116
1952	243.5	122
1953	247.3	124
1954	261.9	123
1955	287.1	115
Average		119

a. Sum of repairs, by type, in Tables 3 and 4, p. 11, above, and Table 5.
b. Total costs divided by the size of the fleet in gross register tons from Table 1, p. 9, above.

Table 7

Estimated Distribution of Vessels of the Maritime Fleet of the USSR, by Age a/
1950-55

Year	Percentage of Ships More Than 12 Years Old	Percentage of Ships More Than 4 Years Old
1950	77	92
1951	77	93
1952	78	93
1953	80	93
1954	80	94
1955	73	90

a. Estimated [redacted]

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APPENDIX C

ESTIMATED COSTS OF MAINTENANCE AND REPAIR IN THE USSR BASED ON ANALOGY WITH US COSTS

The estimated annual average costs of repair per gross register ton for the US maritime fleet were $22 for 1949-55. (See Table 8.*) This estimated average is based on an aggregate made up of all types of ships and repairs and therefore may be applied only to over-all fleet tonnage, not to specific types of ships.

Application of the estimated annual US average of costs of repair, $22 per gross register ton per year, to the Soviet maritime fleet yields the total costs of maintenance shown in Table 9.** These estimates varied with the size of the fleet from a low of $42 million in 1950 to a high of $55 million in 1955.

Not only is it difficult to obtain accurate data on US costs of maintenance and repair, but also there are limitations to the methodology of analogy. These limitations result from the differences between the US and Soviet shipbuilding industries as to ship types and sizes and techniques and standards of maintenance and repair.

US and Soviet standards of maintenance and repair of ships vary widely and therefore are not easily comparable. US standards are among the world's highest, whereas there is a tendency in the USSR to "make do." To keep a ship operating, however, there must be periodic maintenance and repair. The ship's hull must be kept watertight and the main propulsion machinery functioning. These are the major repair costs, and they must be met sooner or later.

Published standards of repair are similar in the US and the USSR. The Soviet standards of repair are listed in the Russian Sea Register. The counterpart in the US is the Rules for Classification and Construction of Steel Vessels, published by the American Bureau of Shipping (ABS). 20/ For example, both the US and Soviet 21/ regulations require an annual survey and special periodic surveys every 4 years to determine the amount of replacement and repair that is necessary to keep the ship operating properly. Every third special periodic survey under ABS rules (a 12-year interval) corresponds roughly to the Soviet rules for capital repair at 12-year intervals.

* Table 8 follows on p. 18.
** Table 9 follows on p. 19.

There are problems of differing age distributions of fleets, much of the Soviet fleet being over-age and therefore needing considerable repair. The fleet, however, is growing rapidly, and recently constructed vessels are not yet in need of major repairs. The best assumption which can be made is that these two factors tend to cancel one another.

US annual costs per gross register ton for maintenance and repair were estimated in the following manner. The dollar volume of ship repair in principal US shipyards was divided by the total active US maritime fleet of vessels of 1,000 GRT or more, for the period 1949-55. These values, which were in current US dollars, were then converted to 1955 dollars by an index of US costs of ship repair. (See Table 10.*)

The values for 1951 and 1952 were higher than those for other years probably because of the demothballing during the Korean War. These years therefore were judged not typical and were dropped in calculating the average cost. The annual average costs of maintenance and repair for the remaining years are $22 per gross register ton. (See Table 8.**)

In order to simplify computations, ships of less than 1,000 GRT were not included in the above calculations. Because the smaller vessels which were ignored represent only a small percentage (4 percent) of the total gross register tonnage, 22/ their exclusion from the calculations yields a somewhat negligible upward bias to the cost.

There is some discrepancy between the aggregate figures for costs of maintenance and repair and the size of the US maritime fleet as presented in Table 8.** The total costs of maintenance and repair do not include repairs to US ships in foreign yards, and figures for the fleet do not include foreign vessels repaired in US yards. It is assumed that the value of repairs to US ships abroad and the value of repairs to foreign ships in US yards are small and would tend to cancel one another. US yards have costs high by foreign standards and are therefore not often used for repairs by foreign vessels. US ships are usually repaired abroad only in emergencies because there is, except for emergency repairs, a 50 percent ad valorem tax on ship repairs made on US ships in foreign yards. The value of US ship repair abroad, therefore, amounts to only about 2 percent of the value of ship repair work done in the principal US yards. 23/

* Table 10 follows on p. 20.
** Table 8 follows on p. 18.

It is estimated that the dollar value of maintenance and repair in US shipyards covers nearly all of the US merchant fleet. The resulting annual costs per gross register ton for the years studied had a range from $23.80 to $20.50. This range is believed to be narrow enough to support the use of an annual average cost per gross register ton to estimate total maintenance and repair costs of a maritime fleet.

Table 8

Costs of Maintenance and Repair of the Maritime Fleet of the US
1949-55

Year	Total Active Fleet a/ (Average Gross Register Tons per Year)	Value of Ship Repair b/ (Current US Dollars)	Repair in Current US Dollars per Gross Register Ton per Year	Index of Costs of Ship Repair c/ (1955 = 100)	Repairs d/ (1955 US Dollars per Gross Register Ton per Year)
1949	10,833,800	197,523,000	18.23	76.5	23.80
1950	9,421,800	152,053,000	16.14	78.7	20.50
1951	10,701,200	267,389,000	24.99	84.8	29.50
1952	13,211,000	315,552,000	23.89	89.1	26.80
1953	11,353,500	234,948,000	20.69	95.0	21.80
1954	9,589,200	196,137,000	20.45	96.8	21.10
1955	9,650,200	218,814,000	22.67	100.0	22.70

a. 23/
b. 24/
c. Figures taken from Table 10, p. 20, below.
d. The average is $22 per gross register ton, see p. 15, above.

Table 9

Costs of Maintenance and Repair of the Maritime Fleet of the USSR a/
1950-55

Year	Gross Register Tonnage of the Maritime Fleet b/	Costs of Maintenance and Repair (Million 1955 US Dollars)
1950	1,922,241	42
1951	1,949,048	43
1952	2,002,175	44
1953	2,000,315	44
1954	2,123,815	47
1955	2,494,192	55

a. Estimated by analogy with US costs. US repairs are estimated at $22 per gross register ton per year.
b. See Table 1, p. 9, above.

Table 10

Index of Estimated Costs of Repair of Maritime Vessels in the US a/
1947-56

Year	Index of Metals and Metal Products Group 10 b/ (1955 = 100)	Weighted 30 Percent	Index of Average Hourly Earnings of Production and Related Workers c/ (1955 = 100)	Weighted 70 Percent	Index (1955 = 100)
1947	66.8	20.0	68.4	47.9	67.9
1948	76.1	22.8	74.0	51.8	74.6
1949	76.8	23.0	76.4	53.5	76.5
1950	80.7	24.2	77.8	54.5	78.7
1951	89.9	27.0	82.5	57.8	84.8
1952	90.0	27.0	88.7	62.1	89.1
1953	92.9	27.9	95.8	67.1	95.0
1954	93.7	28.1	98.1	68.7	96.8
1955	100.0	30.0	100.0	70.0	100.0
1956	109.9	33.0	103.3	72.3	105.3

a. Relative weights are believed to reflect weights of total labor and materials in ship repair.
b. 25/
c. Calculated from the average hourly earnings of production and related workers in the US ship repair industry. 26/

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